TESTIMONY OF NICHOLAS M. DONOFRIO
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Good morning, Mr. Chairman and members of the Committee. Thank you for inviting me to join you today. My name is Nicholas Donofrio and I am the executive vice president for Innovation and Technology in the IBM Corporation. I appreciate the opportunity to offer IBM's views on U.S. competitiveness and the innovation challenge. Given the fundamental role of innovation in underpinning American economic growth and national security, I believe this hearing is more important now than ever.

I also wish to thank Chairman Boehlert for his longstanding support of science, technology and innovation. Under his leadership, this Committee has been an outstanding proponent for the pillars of growth in our society – namely, research, technology and skills development.

I will focus my testimony today on the principal innovation challenges we face -- both inside IBM and within the information technology industry – as we compete in the global economy. You also have asked me to provide my views on the role innovation plays in driving the competitiveness of the United States.

With regard to IBM, no longer are we focused exclusively on the development, manufacture and delivery of information technology, but rather on the application and integration of technology to deliver new and lasting value to our clients around the world. We have conducted an end-to-end transformation of our business, driven by major new global marketplace realities and opportunities. As a company with $96 billion in revenue, and which operates in 174 countries, we believe we bring unique insight to global trends and a solid base from which to make national recommendations. IBM is aligned around a single, focused business model – innovation. Innovation that is collaborative, open and multi-disciplined.

TRENDS

History suggests that a sustained period of growth is about to begin for the $1.4 trillion information technology industry. At the same time, new markets are opening up on its borders. We believe that the drivers of growth are very different today and will remain so for the foreseeable future; they are propelling information technology and business services, and they are affecting not only IBM and the IT industry, but also the American economy as a whole. Further, a major factor in the accelerated growth of the American economy in the post-1995 period has been the increase in productivity gained by the application of information technology to business processes.

The rewards of that growth will not be shared equally; they will, as in the past, flow to those enterprises and nations that can innovate and turn disruptive shifts to their advantage. Such conviction is what sharpens our focus on innovation in IBM, for the benefit of our clients and the nations where we conduct business.

Our economy today is moving into a new era, underpinned by cyber-infrastructure, a new architecture of computing and the new business models they enable. The essential ideas about the networked organization and global economy are clearly taking hold. Those changes are driven by the convergence of three historic developments:

Network Ubiquity: In less than a decade, the Internet -- the most visible evidence of an increasingly networked world -- has reached some 800 million people, and is projected by some analysts to reach more than a billion people by 2007. The Internet has not only connected people and opened up access to the world's information, it is rapidly becoming the planet's operational infrastructure. It is linking people, businesses and institutions, as well as billions -- ultimately trillions -- of devices. It is facilitating and transforming transactions of all kinds - from commerce, government services, education and health care, to entertainment, conversation and public discourse.

Open Standards: Technical and transaction specifications underpin all industries. When they become standards -- that is, when they are widely adopted -- they enable growth by spurring the creation of many new kinds of products and services. Standards made possible electrical, telephone and TV networks, CDs, DVDs, credit and debit cards and global financial markets — and by extension, all the other business and public services those systems enabled. Today, standards are truly taking hold in information technology. They determine how computers operate and software applications are developed, how digital content is produced, processed, distributed and stored, and how transactions of all types are managed. These standards are "open" — that is, not owned or controlled by any one company or entity. (The Internet itself, for example, is built on open standards.) This is common in other industries, but a radical departure for the information technology industry.

New Business Designs: The simultaneous emergence of the networked world and open standards is enabling entirely new business designs, giving CEOs and other decision-makers options that were not feasible before. Companies can now be far more flexible and responsive to changes in the economy, buyer behavior, supply, distribution networks, consumer tastes, geopolitical realities — even the weather. That is because their business operations can be integrated horizontally, from the point of contact with customers through the extended supply chain. And because vital information is captured and managed enterprise-wide, networked companies can anticipate and respond much faster, or, in other words, on demand.

The fundamental shifts I have described are creating significant competitive advantages for institutions around the world, particularly in the management and integration of their business processes. Companies are innovating in new areas, such as supply chain management, engineering design services, human resource management, after-sales services and customer care. Governments are transforming their legacy agencies to organize around missions rather than departments. Academic institutions are delivering their courseware through the Internet in addition to the traditional classroom. Institutions are radically innovating in their business operations and processes using information technology and the services and expertise associated with business process transformation.

This new organizational structure and marketplace are growing dramatically, and American industry is at the forefront. We see global opportunity in excess of $500 billion that can be addressed by both information technology and non-information technology companies.

Enterprises around the world are innovating through the transformation of their businesses because they recognize that new and integrated processes result in genuine competitive advantage.

INDUSTRY CHANGE

Like other major structural shifts before it, the new era — networked, built on standards and with wholly new business and institutional models — is opening up new possibilities for profit and growth for business, while also affecting other realms of societal and economic activity -- from government, to health care, to education.

Seizing the opportunities presented by that shift, as always, requires unique foresight and capabilities. Despite the turmoil in the economy in recent years, some nations have managed to increase their prosperity, advance the frontiers of science and learning, and build multiple kinds of new expertise. For them, the result today is an economy poised for sustained growth in traditional markets and robust growth in the new markets. But, as I mentioned, the growth will not be shared equally. In the years ahead, choosing wisely will prove important. Significant rewards will accrue to those who are up to the challenge.

Capabilities, investments and infrastructure are increasing everywhere. Global interconnections make it possible for people to work from virtually anywhere. The world is indeed becoming more tightly integrated. For American companies in a broad range of industries – as well as governments – the choice is either innovation or commoditization.

Companies that create new, high-demand technologies and services enjoy, for a time, barriers to entry, as well as superior margins and pricing power, since there are few other providers of that technology or service. However, alternative technologies or capabilities inevitably emerge, decreasing the innovator's advantages. In short, that segment of the industry "commoditizes." There are still attractive opportunities to be pursued, but with much less profit potential.

The global innovation-commoditization cycle has never been more pronounced than it is today, and it forces distinct choices. Winners can be the innovators — those with the capacity to invest, manage and leverage the creation of intellectual capital — or the commodity players, who differentiate through low price, economies of scale and efficient distribution of other parties' intellectual capital.

Perhaps the greatest risk is to get squeezed in the middle — being attacked by low-price competitors, while lacking the expertise and intellectual capital to keep up with the most aggressive innovators.

GLOBAL TRENDS AND OPPORTUNITY

The dilemma affects nations, as well as industries. Understanding, anticipating and managing the forces of innovation and commoditization can address many of the challenges to national economic success. Today, companies and organizations are coming to a new way of conceptualizing and managing business activity. Essentially, they are choosing to move to a higher value space in the overall national economic picture. A networked, interconnected model enables them to achieve higher levels of responsiveness, flexibility and efficiency than legacy, Industrial-Age business models. This new flexibility offers great potential for growth, by increasing productivity and by creating entirely new capabilities.

There are many examples of new capabilities. In health care, for instance, we now see personalized medicine on the horizon — as the integration of patient histories and genomic data is changing the nature of diagnosis and patient care. In insurance, we see products and services tailored to the driving habits of individual policyholders.

So, how do we, as a nation, enable that transformation? How do we capitalize on the most important developments in technology, infrastructure and business organization in which we currently have global leadership? How do we translate those developments into differentiators for American prosperity? How do we strategically align ourselves to innovate and leverage the networked world, based on a combination of expertise, advanced technology, and business insight, for productivity gains and economic success? In short, how do we optimize for innovation?

MOVING TO THE FUTURE

Innovation has become the new arbiter of national competitiveness. We must recognize innovation as a national priority. For the United States to thrive in the hyper-competitive world economy we must, with urgency, mobilize business, government, educators and researchers to adopt innovation as a core strategy to build the foundation for a 21st Century knowledge- based economy.

Innovation success will be a product of many stakeholders collaborating and sharing the risk of change. To facilitate the process, our nation's policy architecture must be modernized to address the changing nature of innovation, the new opportunities I have described and the new global competitors. The redesign of our nation's innovation policies must be balanced, consistent and coordinated, and focused on crucial challenges.

INNOVATION ECOSYSTEM: A KEY CONCEPT

Achieving national innovation success is complex. It requires far more than the management of ideas, technology transfer and research and development. The challenge is not only to generate fresh ideas and intellectual property, but to transform ideas and intellectual property into new value. As such, they become commercially successful. The private sector is the primary agent for innovation. The Federal government, however, has enormous influence over the pace of fundamental knowledge advances, the incentive for private enterprises to invest in innovation and the conditions under which innovation may thrive.

Innovation is not just R&D driven. It needs to be viewed on both the supply and demand side, and in a global perspective. A basic prerequisite for the next generation of innovation policies is to move toward a thoughtful integration with all the dynamics of the ***National Innovation Ecosystem***, as illustrated in the following chart:

THE NATIONAL INNOVATION ECOSYSTEM

The push and pull of supply and demand do not occur in a vacuum. They are strongly influenced by public policy and the overall infrastructure for innovation offered by our society.

Public policies related to education and training, research funding, regulation, fiscal and monetary tools, intellectual property and market access demonstrably affect our ability to generate innovation inputs and respond to innovation demands.

The same can be said of infrastructure – be it transportation, energy, health care, information technology networks or communications. Taken together, the policy and infrastructure environments create a national platform that can accelerate – or impede – the pace and quality of innovation. [Excerpted from*:* InnovateAmerica, Report of the National Innovation Initiative, December 2004]

AN INTEGRATED POLICY APPROACH REQUIRED

In 2004, IBM Chairman and Chief Executive Officer Sam Palmisano co-chaired the National Innovation Initiative of the Council on Competitiveness. One of the central findings of its report is that the United States needs an *integrated*, coherent approach across a number of policy arenas to maintain global economic leadership. The total mix and composition of federal policies affect private sector innovation behavior.

Many of the critical choices lie outside the traditional sphere of research and development and innovation supply policies. Policies which influence the supply of talent, risk capital, the demand for innovative goods and services and the robustness of regional innovation networks also are important. A higher level of national innovation performance will result from an integrated end-to-end *(idea to market)* approach by the federal government. The vitality of the ecosystem will stimulate innovation. Focusing only on the discrete components – investing in schools or sector-specific initiatives – is not enough. We must find ways to address the entire ecosystem.

The National Innovation Initiative report presents recommendations under three broad themes: talent, investment and infrastructure. They represent a new approach to drive U.S. competitiveness – making clear that innovation is not a checkpoint on the economic agenda, but rather the organizing principle of the agenda. If the U.S. seeks to remain the most attractive and fertile environment for innovation in the world, such policy measures must be pursued as a coherent and clearly-articulated strategy.

COMPONENTS OF A NATIONAL INNOVATION POLICY

The highest-leverage policy choices for consideration in a national innovation policy include:

1. *Establishing an innovation focal point within the Executive Office of the President to frame, assess and coordinate strategically the future direction of the nation's innovation policies.*

2. *Creating new metrics for the national innovation ecosystem to drive performance and monitor results. New metrics of the knowledge-based economy should include knowledge indicators, contractual agreements like strategic partnerships, IP licensing, and conditions for innovation, such as economic demand, public policy environment and infrastructure readiness.*

3. *Implementing new tax incentives to provide scholarships for the next generation of scientists, engineers and innovators and changing immigration policies to attract and retain the brightest talent from around the world.*

4. *Accelerating innovation oriented learning environments at the K-12 level, enhancing careers options and the adaptability of workers through portable learning benefits.*

5. *Modifying the long-term Federal R&D investment portfolio by a new priority on the physical and engineering sciences, setting aside an increased proportion of research funding to basic, novel, high-risk and exploratory research, establishing a research program for the services sciences, encouraging multidisciplinary research, and making permanent a restructured R&D tax credit including university-industry collaborations.*

6. *Coordinating and focusing federal economic development programs on regional innovation hotspots and creating more dynamic innovative industry clusters.*

7. *Implementing a legal and regulatory framework that encourages voluntary and more complete disclosure of business intellectual ("intangible") assets and longer term innovation strategies.*

8. *Supporting a new US production capability in emerging technologies through creation of world class Centers for Production Excellence, strengthening DOD's historic role in advanced manufacturing research, reorganizing the Manufacturing Extension System toward innovation services for small to medium sized enterprises and supporting an open systems approach to customer relationship, product design, supply chain, manufacturing and logistics systems.*

9. *Capitalizing on innovation opportunities in hydrogen fuel cells, nanotechnology, new materials, micro-machining, advanced semi-conductor technology, broadband deployment and applications, next generation wireless devices, digital medical records and health care, pervasive computing, modeling and simulation*.

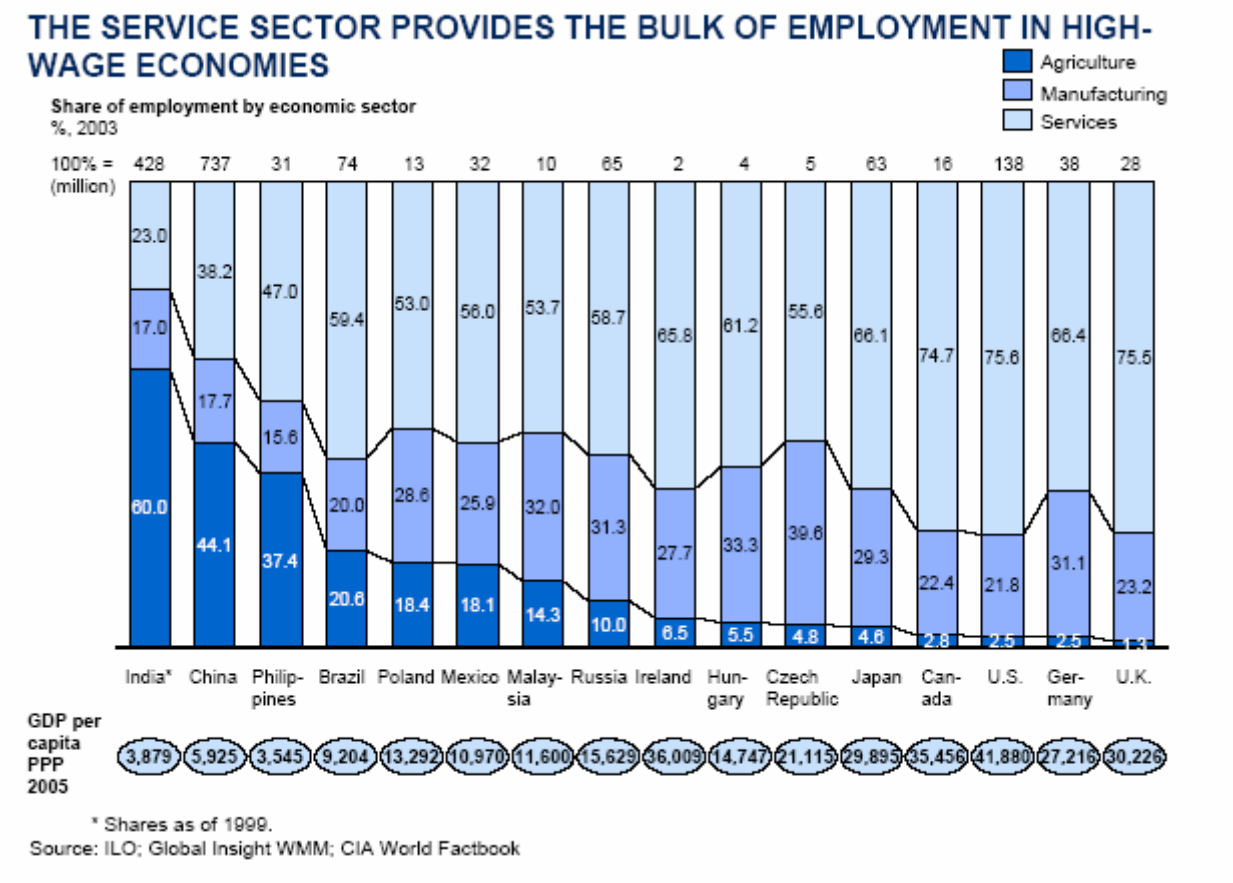
EDUCATION, TRAINING AND WORKFORCE

I will now comment on several areas of education, training and workforce development which contribute to our nation's innovation system and competitive position.

Competitive advantage today comes from expertise – and expertise is not static. The United States needs the world's deepest, most diverse collection of business and technology innovators, supported by advanced collaboration systems and a culture that enables continuous learning. In the Agricultural Age, land and farm production defined competitive advantage. In the Industrial Age, it was raw materials and manufacturing capability. Today, it is the ability to create and apply intellectual capital based on multidimensional expertise.

Workforce skills must include both technology and strategic expertise. An understanding of technology — its current capabilities as well as its future potential — is now integral to business decision making. Business leaders need innovation partners who are at the frontiers of research and deeply steeped in the issues and dynamics of specific industries.

To advance strategic expertise, the nation's structural transition to a services economy needs to be supported by a deepened understanding of how services support and interact with manufacturing and other more traditional activities. In fact, in today's global economy, the services sector provides the bulk of employment in high-wage economies. See attached chart:



A wide community is beginning to discuss the technical and social effects of new developments in global connectivity, automation, technology integration and Web services and a new scientific discipline is being opened. Leading universities are beginning to work with IBM to better understand the social and technical issues involved in collaborating across global enterprises. For example, the University of California at Berkeley is considering the implementation of a Services Science curriculum in conjunction with IBM Research -- much in the way the first Computer Science department was initiated at Columbia University. Federal research investment and collaboration could significantly accelerate learning in this area.

To advance technology expertise, I am convinced that education must be transformed and realigned to prepare students to become innovators. Reform must start with curriculum. Creative and integrative instruction can be achieved through the development of Problem-Based Learning (PBL) – a methodology that is sure to enhance the development of much-needed skills – especially in the engineering and technical professions. PBL is specifically helpful in the development of scientific, mathematical and technical talent. It focuses on ill-structured problem solving, and provides deeper meaning, applicability and relevancy to classroom materials and the development of crucial analysis skills that are required in the workplace. An education system designed to support curriculum focused on acquiring discreet skills and memorizing information will not produce the leaders and innovators the world needs.

In my own industry, these needs are particularly acute. The information technology sector is experiencing a pronounced shift in demand for specialized skills that fuse industry-specific knowledge, information technology capability and business process expertise. These skills enable the business transformations described earlier. Organizations seek more integrated and customized technology and services solutions that create competitive advantage and enable innovation. New information technology jobs are mushrooming in areas like business analysis, security analysis, vendor management, service management, system integration, and others. IBM's clients seek business acumen, project management and leadership skills along with specific IT skills linked to open standards, networking and e-commerce. These emerging occupations require higher skills and they are well paid.

Finally, we must realize that we benefit greatly from a diversity of talent, a diversity of culture, a diversity of thought and insight from all over the world --- intra-national and international. Innovation does not happen in isolation. It happens through collaboration across the diverse communities required to sustain economic leadership in the 21st century. We need national immigration policies that enable the United States to attract and retain the best minds in the world.

In an expertise-based, global marketplace, the expansion of business into more diverse services is forcing us to re-think the types of skills and educational degrees that are needed to drive America forward. In fact, the whole services paradigm is enabling us to be more innovative in our approach to talent development.

Applied more broadly, our experience drives me to conclude that America needs a culture of learning, skill building and collaboration. Specifically, it means that technologists and business experts need to work closely together, not simply to share insights, but to create entirely new intellectual capital for competitive advantage. We must build the capacity to apply new intellectual property to nurture and launch new high-value businesses.

Unlocking innovation also demands that we rethink our ideas about intellectual property. Some believe the best way to provide incentives for innovation is by fiercely protecting the inventor's proprietary interest. Others argue that we should open the doors and give full access to intellectual assets. I believe we need a new path forward, an approach that offers a balance of those two extremes.

While IP ownership is an essential driver of innovation, technological advances are often dependent on shared knowledge, standards, and collaborative innovation. The IP framework must enable both. We must protect truly new, novel and useful inventions. And we need to recognize that open standards can accelerate the interoperability and expansion of the global infrastructure. Because collaborative innovation is relatively new, the structure and processes to accommodate ownership, openness and access are evolving, and new creative models are emerging. This is an area of tremendous promise and is currently being addressed in patent legislation in the Judiciary Committee.

SUMMARY

Economies around the world are replicating the characteristics that have given Western nations such an advantage – open markets, R&D investment and highly-trained workers. Many companies in rapidly developing nations such as China, India, Brazil and Russia are leapfrogging to new computing architectures and business designs. Emerging nations with limited legacy infrastructures are developing specific innovation strategies. They plan to drive economic growth by leapfrogging in infrastructure development. These approaches are creating a highly competitive global economy.

As the United States considers its next steps, I urge that any dialogue on innovation must be made in the global context. The forces of global economic integration – and advances in technology – are presenting complex challenges that can only be addressed by embracing opportunities for change and future prosperity. The status quo simply cannot be an option.

Governments, business, academia and labor must work together to create a climate and a culture that facilitates cross-border, cross-organizational and cross-disciplinary collaboration. That is the only environment in which innovation will thrive.

America has a long and proud track record of recognizing when change is required, and then rising to the challenge. We are at such an inflection point today. I am very enthusiastic about seizing the opportunities before us and prospering in the decades ahead.

Thank you for the opportunity to be with you today.